

**Group Work Questions:**

A. Step back for a moment. In your group's own words, explain the following ideas:

Gravitational energy: THE MOVEMENT DUE TO THE ATTRACTION BETWEEN 2 THINGS

Thermal energy: THE MOVEMENT CAUSED BY HEAT

Chemical energy: THE ENERGY USED ~~TO~~ INBETWEEN BONDS + TO BREAK BOND.

Buoyancy: THE RISE AND FALL OF MATERIALS DUE TO THEIR RELATIVE DENS.

Lithosphere: THE UPPER PART OF THE EARTH INCLUDING THE CRUST ~~AND UPPER~~ <sup>BELOW CRUST</sup>

Asthenosphere: THE PART UNDER THE LITHOSPHERE, CONSISTS OF ROCKS THAT CAUSE

Why Melting Occurs at Subduction Zones: ASTH. MELTS DUE TO COMPOSITION, BENDS MOVING WATER IN THE CRUST LEAVES THE CRUST + RISES TO MELT THE ASTH.

**MAKE SURE EVERYONE UNDERSTANDS THESE IDEAS BEFORE MOVING ON!**

B. When magma rises through the crust, the magma cools and the crust gets hotter as heat is transferred from the magma to the crust. Explain what happens to density during this process and how it will affect a magma rising through the crust: <sup>CRUST BECOMES</sup> LESS DENSE,

Magma cooling: BECOMES MORE DENSE, SETTLES AND HARDENS

Crust warming: BECOMES LESS DENSE, ~~IT~~ RISES UP W/THE MAGMA, CREATES NEW CRUST (?)

C. Ocean crust is dense and composed mostly of basalt, while continental crust is lower in density and composed mostly of granite. Considering the density differences, would the buoyant force on a basaltic magma be greater in the ocean crust or the continental crust? Explain your reasoning.

Because basalt is denser than granite, basaltic magma is also less dense than granitic magma meaning that the buoyant force of basaltic magma and continental crust would be greater because there is a greater difference in density.

ISP203A – Global Change  
Buoyancy

**Part 2. Group Work**

In Table C, align the driving energies that correspond with the hot air balloon and the magma. Not all aspects of the hot air balloon will necessarily align with magma. Explain how the hot air balloon and magma are different in Table D.

Table C. Comparing Hot Air Balloon and Magma

Hot Air Balloon	Magma	Driving Energy
Gas flame	Water added to hot rocks deep underground	Thermal
Differences in air inside and outside the balloon	Difference in the cold lithosphere and the hot magma	Density, Thermal
Balloon rising	Magma Rising	Gravitational
Balloon floating	Magma solidifies and stops rising	Equilibrium
Outside air heating up during the day	Oceanic lithosphere vs. continental lithosphere	Solar Energy (Thermal)

Describe specific factors that affect density and buoyancy for the hot air balloon system and the magma system.

Table D. Differences Between Hot Air Balloon and Magma

Hot Air Balloon	Difference	Magma
Air Temperature	Factors impacting density of balloon/magma	Composition of Asthenosphere after water is added.
Heat applied to Balloon makes it less dense than air around it	Factors impacting buoyancy	After melting, hot magma rises because it is less dense than the lithosphere and crust.

**Group Work Questions:**

A. Step back for a moment. In your group's own words, explain the following ideas:

Gravitational energy: ~~MOVEMENT~~ THE ENERGY PULLING THINGS TO THE CENTER OF EARTH

Thermal energy: THE ENERGY CAUSED BY THE MOVEMENT OF PARTICLES

Chemical energy: THE CHANGE IN MOLECULES STORED IN BONDS

Buoyancy: RISING OR FALLING OF MATERIALS DUE TO THEIR DENSITY

Lithosphere: COLD, BRITTLE LAYER OF ROCK

Asthenosphere: WARMER, BENDABLE LAYER WHERE MELTING OCCURS

Why Melting Occurs at Subduction Zones: TEMPERATURE COLDER;

Composition CAUSES melting, THROUGH WATER BEING ADDED

**MAKE SURE EVERYONE UNDERSTANDS THESE IDEAS BEFORE MOVING ON!**

B. When magma rises through the crust, the magma cools and the crust gets hotter as heat is transferred from the magma to the crust. Explain what happens to density during this process and how it will affect a magma rising through the crust:

Magma cooling: As magma cools it becomes more dense, causing magma to rise slower than if it were heated more.

Crust warming: As the crust warms it becomes ~~more~~ less dense and rises to the top.

C. Ocean crust is dense and composed mostly of basalt, while continental crust is lower in density and composed mostly of granite. Considering the density differences, would the buoyant force on a basaltic magma be greater in the ocean crust or the continental crust? Explain your reasoning.

Continental Crust would be more buoyant and that is because it is less dense, causing it to float more than the basalt in the ocean crust.

**Group Work Questions:**

A. Step back for a moment. In your group's own words, explain the following ideas:

*Gravitational energy:* objects moving from higher to lower elevations.

*Thermal energy:* objects changing due to a change in temp.

*Chemical energy:* objects changing due to a change in composition.

*Buoyancy:* the force that is equal to the surrounding environ. it displaces.

*Lithosphere:* the layer of the earth that is cold & lays on top of the

*Asthenosphere:* layer that is bendable & warm. asthenosphere

*Why Melting Occurs at Subduction Zones:*

Compositional change due to adding water.

**MAKE SURE EVERYONE UNDERSTANDS THESE IDEAS BEFORE MOVING ON!**

B. When magma rises through the crust, the magma cools and the crust gets hotter as heat is transferred from the magma to the crust. Explain what happens to density during this process and how it will affect a magma rising through the crust:

Magma cooling:

density will  $\uparrow$  and magma rise slower, but it will continue to rise b/c it is less dense than the crust.

Crust warming:

density will  $\downarrow$  with increasing temps, but the magma will still rise b/c it is still less dense than the surrounding crust.

C. Ocean crust is dense and composed mostly of basalt, while continental crust is lower in density and composed mostly of granite. Considering the density differences, would the buoyant force on a basaltic magma be greater in the ocean crust or the continental crust? Explain your reasoning.

The buoyant force on a basaltic magma would be greater in the continental crust because continental crust is less dense.

## Part 2. Group Work

In Table C, align the driving energies that correspond with the hot air balloon and the magma. Not all aspects of the hot air balloon will necessarily align with magma. Explain how the hot air balloon and magma are different in Table D.

Table C. Comparing Hot Air Balloon and Magma

Hot Air Balloon	Magma	Driving Energy
Gas flame	Water added to hot rocks	thermal
Differences in air inside and outside the balloon	difference in cold lithosphere & hot magma	thermal (buoyancy)
Balloon rising	magma rising	Gravitational
Balloon floating	magma solidifies & stops rising	equilibrium
Outside air heating up during the day	oceanic lithosphere versus continental lithosphere	thermal

Describe specific factors that affect density and buoyancy for the hot air balloon system and the magma system.

Table D. Differences Between Hot Air Balloon and Magma

Hot Air Balloon	Difference	Magma
thermal	Factors impacting density of balloon/magma	changing composition → Adding Water!
temperature	Factors impacting buoyancy	composition

**Group Work Questions:**

A. Step back for a moment. In your group's own words, explain the following ideas:

*Gravitational energy:* NRG that produces force on a ~~force~~ material.

*Thermal energy:* NRG that produces heat.

*Chemical energy:* NRG that comes from atoms.

*Buoyancy:* The ability to float or sink.

*Lithosphere:* The solid crust of the earth

*Asthenosphere:* The solid, yet bendable crust of the earth.

*Why Melting Occurs at Subduction Zones:* because of the composition due to added water.

**MAKE SURE EVERYONE UNDERSTANDS THESE IDEAS BEFORE MOVING ON!**

B. When magma rises through the crust, the magma cools and the crust gets hotter as heat is transferred from the magma to the crust. Explain what happens to density during this process and how it will affect a magma rising through the crust:

Magma cooling: When magma is cooling the density increases which will slow or stop the rising through the crust because it will solidify.

Crust warming: When the crust warms the density will decrease due to the higher temp, which will allow the magma to rise because it is not longer as solid pushing the magma down.

C. Ocean crust is dense and composed mostly of basalt, while continental crust is lower in density and composed mostly of granite. Considering the density differences, would the buoyant force on a basaltic magma be greater in the ocean crust or the continental crust? Explain your reasoning.

It would be greater in the ocean crust because of the composition of the oceanic crust which takes up more space once leaves less room to sink and because of density cliffs water cause the buoyant force to be greater.

## Part 2. Group Work

In Table C, align the driving energies that correspond with the hot air balloon and the magma. Not all aspects of the hot air balloon will necessarily align with magma. Explain how the hot air balloon and magma are different in Table D.

Table C. Comparing Hot Air Balloon and Magma

Hot Air Balloon	Magma	Driving Energy
Gas flame	Water added to hot rocks	Not match
Differences in air inside and outside the balloon	Diffs in cold lithosphere & hot magma	thermal NR
Balloon rising	Magma Rising	Gravitational
Balloon floating	Magma solidifies & stops rising	equilibrium
Outside air heating up during the day	Oceanic vs continental lithosphere	NO match

Describe specific factors that affect density and buoyancy for the hot air balloon system and the magma system.

Table D. Differences Between Hot Air Balloon and Magma

Hot Air Balloon	Difference	Magma
thermal	Factors impacting density of balloon/magma	thermal
Gravity	Factors impacting buoyancy	Gravity

**Group Work Questions:**

A. Step back for a moment. In your group's own words, explain the following ideas:

**Gravitational energy:** Potential energy due to gravity

**Thermal energy:** Kinetic energy of movement of atoms and molecules

**Chemical energy:** Potential of a chemical substance to undergo transformation through a chemical reaction.

**Buoyancy:** Tendency to remain afloat in a liquid or rise in air or gas.

**Lithosphere:** outer solid part of the earth

**Asthenosphere:** least rigid portion of the mantle, soft/easily deformed layer.

**Why Melting Occurs at Subduction Zones:** The movement and friction between plates cause a lot of heat, plus heat from mantle + radioactive decay, causes the subducted plate to melt.

**MAKE SURE EVERYONE UNDERSTANDS THESE IDEAS BEFORE MOVING ON!**

B. When magma rises through the crust, the magma cools and the crust gets hotter as heat is transferred from the magma to the crust. Explain what happens to density during this process and how it will affect a magma rising through the crust:

**Magma cooling:** Magma cooling causes it to become less dense sinking into the crust.

**Crust warming:** The crust warming causes the magma to increase in temperature also making it more dense. This will cause the magma to rise + eventually break through the crust creating a volcano.

C. Ocean crust is dense and composed mostly of basalt, while continental crust is lower in density and composed mostly of granite. Considering the density differences, would the buoyant force on a basaltic magma be greater in the ocean crust or the continental crust? Explain your reasoning.

The buoyant force on a basaltic magma would be greater in the ocean crust rather than the continental crust. The ocean crust is more dense giving more buoyant force to the magma.



## Part 2. Group Work

In Table C, align the driving energies that correspond with the hot air balloon and the magma. Not all aspects of the hot air balloon will necessarily align with magma. Explain how the hot air balloon and magma are different in Table D.

Table C. Comparing Hot Air Balloon and Magma

Hot Air Balloon	Magma	Driving Energy
Gas flame	water added to hot rocks deep underground	Thermal Energy
Differences in air inside and outside the balloon	Differences in the cold lithosphere + the hot magma	density difference due to temp. Thermal Energy (buoyancy)
Balloon rising	magma rising	Gravitational Energy
Balloon floating	magma solidifies and stops rising	XXX
Outside air heating up during the day	ocean lithosphere versus continental lithosphere	Solar energy (thermal)

Describe specific factors that affect density and buoyancy for the hot air balloon system and the magma system.

Table D. Differences Between Hot Air Balloon and Magma

Hot Air Balloon	Difference	Magma
Heat	Factors impacting density of balloon/magma	Heat
Density	Factors impacting buoyancy	Density

**Group Work Questions:**

A. Step back for a moment. In your group's own words, explain the following ideas:

Gravitational energy: Amount of pull towards the Earth's surface

Thermal energy: Differences in temperature causing changes

Chemical energy: The composition of objects & how it changes

Buoyancy: Ability of object to float

Lithosphere: Earth's Surface, top layer, brittle

Asthenosphere: Earth Surface, under lithosphere, bendable

Why Melting Occurs at Subduction Zones: Where lithosphere is at the exact right spot in order to have H<sub>2</sub>O melt the rocks & change composition

**MAKE SURE EVERYONE UNDERSTANDS THESE IDEAS BEFORE MOVING ON!**

B. When magma rises through the crust, the magma cools and the crust gets hotter as heat is transferred from the magma to the crust. Explain what happens to density during this process and how it will affect a magma rising through the crust:

Magma cooling: When magma cools, it gets more dense which will slow the rising process down & eventually come to a stop.

Crust warming: When the crust warms, the density decreases which allows the magma to rise at a faster speed because it's not weighing the magma down.

C. Ocean crust is dense and composed mostly of basalt, while continental crust is lower in density and composed mostly of granite. Considering the density differences, would the buoyant force on a basaltic magma be greater in the ocean crust or the continental crust? Explain your reasoning.

The buoyant force on basaltic magma would be greater in the ocean crust because the oceanic basalt is more dense & would allow objects to float easier, just as people float easier in salt water rather than fresh water.

ISP203A – Global Change  
Buoyancy

**Part 2. Group Work**

In Table C, align the driving energies that correspond with the hot air balloon and the magma. Not all aspects of the hot air balloon will necessarily align with magma. Explain how the hot air balloon and magma are different in Table D.

Table C. Comparing Hot Air Balloon and Magma

Hot Air Balloon	Magma	Driving Energy
Gas flame	Water added to hot rocks	No match
Differences in air inside and outside the balloon	cold lithosphere & hot magma	Thermal
Balloon rising	magma rising	Gravitational
Balloon floating	magma solidified & stops rising	Equilibrium
Outside air heating up during the day	oceanic lithosphere vs. continental lithosphere	No match

Describe specific factors that affect density and buoyancy for the hot air balloon system and the magma system.

Table D. Differences Between Hot Air Balloon and Magma

Hot Air Balloon	Difference	Magma
heat differences inside & outside of balloon.	Factors impacting density of balloon/magma	heat of rocks & gravitational pull
GRAVITY	Factors impacting buoyancy	GRAVITY

## Part 2. Group Work

In Table C, align the driving energies that correspond with the hot air balloon and the magma. Not all aspects of the hot air balloon will necessarily align with magma. Explain how the hot air balloon and magma are different in Table D.

Table C. Comparing Hot Air Balloon and Magma

Hot Air Balloon	Magma	Driving Energy
Gas flame	diffs. in cold litho. & the hot magma	Thermal
Differences in air inside and outside the balloon	Oceanic litho. vs. continental litho.	density diff. - Thermal
Balloon rising	magma rising	gravitational
Balloon floating	magma solidifies & stops rising	xxx equilibrium
Outside air heating up during the day	xxx	solar (thermal) energy

Describe specific factors that affect density and buoyancy for the hot air balloon system and the magma system.

Table D. Differences Between Hot Air Balloon and Magma

Hot Air Balloon	Difference	Magma
Temperature	Factors impacting density of balloon/magma	composition
density	Factors impacting buoyancy	density

7

GROUP #:  
Student IDs of Members Present:

**Group Work Questions:**

A. Step back for a moment. In your group's own words, explain the following ideas:

*Gravitational energy: pulls objects together*

*Thermal energy: energy from movement of molecules*

*Chemical energy: energy due to the structure / formation of molecules*

*Buoyancy: equal force to the weight of the water the object is in*

*Lithosphere: made up of crust and mantle*

*Asthenosphere: upper mantle of Earth, below Lithosphere*

*Why Melting Occurs at Subduction Zones: Water mixes with the minerals of the ocean floor and makes the melting temperature different*

**MAKE SURE EVERYONE UNDERSTANDS THESE IDEAS BEFORE MOVING ON!**

B. When magma rises through the crust, the magma cools and the crust gets hotter as heat is transferred from the magma to the crust. Explain what happens to density during this process and how it will affect a magma rising through the crust:

*Magma cooling: the density decreases so it rises (sinks less)*

*Crust warming: crust gets hotter, gets less dense*

C. Ocean crust is dense and composed mostly of basalt, while continental crust is lower in density and composed mostly of granite. Considering the density differences, would the buoyant force on a basaltic magma be greater in the ocean crust or the continental crust? Explain your reasoning. *It would be more buoyant in the oceanic crust because the density difference is larger*

GROUP #: 8  
Student IDs of Members Present:  
A43866027  
A39223581 A42311708  
A40833474

**Group Work Questions:**

A. Step back for a moment. In your group's own words, explain the following ideas:

Gravitational energy: attraction of mass draws objects together

Thermal energy: movement of molecules

Chemical energy: arrangement of atoms and molecules

Buoyancy: less dense objects rising above more dense objects.

Lithosphere: crust and upper most mantle

Asthenosphere: Below lithosphere.

Why Melting Occurs at Subduction Zones: right pressure for water change  
melting rate to occur at that depth composition

**MAKE SURE EVERYONE UNDERSTANDS THESE IDEAS BEFORE MOVING ON!**

B. When magma rises through the crust, the magma cools and the crust gets hotter as heat is transferred from the magma to the crust. Explain what happens to density during this process and how it will affect a magma rising through the crust:

Magma cooling:

magma gets more dense as it cools

Crust warming:

once magma is as dense as  
the crust is when it's at  
equilibrium

C. Ocean crust is dense and composed mostly of basalt, while continental crust is lower in density and composed mostly of granite. Considering the density differences, would the buoyant force on a basaltic magma be greater in the ocean crust or the continental crust? Explain your reasoning.

~~buoyant force would be greater~~

The difference between the melted  
basalt and the solid basalt is greater  
than the density difference between  
the melted basalt and the solid granite

8

## Part 2. Group Work

In Table C, align the driving energies that correspond with the hot air balloon and the magma. Not all aspects of the hot air balloon will necessarily align with magma. Explain how the hot air balloon and magma are different in Table D.

Table C. Comparing Hot Air Balloon and Magma

Hot Air Balloon	Magma	Driving Energy
Gas flame	water added to hot rocks deep underground	Thermal
Differences in air inside and outside the balloon	Differences in cold lithosphere and hot magma	Thermal
Balloon rising	<del>mag</del> magma rising	Gravitational
Balloon floating	magma solidifies and stops rising	Equilibrium / chemical
Outside air heating up during the day	Increase temp by going deeper into Earth	Thermal

Describe specific factors that affect density and buoyancy for the hot air balloon system and the magma system.

Table D. Differences Between Hot Air Balloon and Magma

Hot Air Balloon	Difference	Magma
Temperature of air  <u>Thermal</u>	Factors impacting <u>density</u> of balloon/magma	Composition of the material  <u>Composition</u>
Hot air less dense than air around it	Factors impacting <u>buoyancy</u>	Magma less dense than rock around it

**Group Work Questions:**

A. Step back for a moment. In your group's own words, explain the following ideas:

Gravitational energy: Energy forces that pull objects towards Earth's core

Thermal energy: Energy of molecular motion

Chemical energy: the energy between bonds of molecules

Buoyancy: force equal to amount of water weight being displaced by an object in

Lithosphere: crust, breaks easily

Asthenosphere: solid, moldable layer of crust beneath lithosphere

Why Melting Occurs at Subduction Zones: composition change (salt water added into magma)

**MAKE SURE EVERYONE UNDERSTANDS THESE IDEAS BEFORE MOVING ON!**

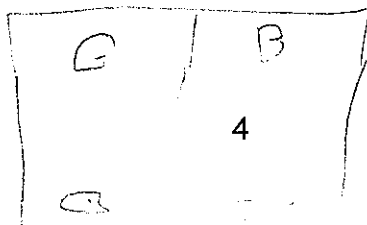
B. When magma rises through the crust, the magma cools and the crust gets hotter as heat is transferred from the magma to the crust. Explain what happens to density during this process and how it will affect a magma rising through the crust:

Magma cooling: When magma cools, it becomes more dense because its molecules have less thermal energy and become closer together. This ensures that there are more molecules in a given space, which causes the more dense magma to solidify since it is as dense as the material around it.

Crust warming: <sup>when</sup> crust is heated, it is becoming less dense because it has more thermal energy and its molecules are moving faster. This causes the crust to melt and rise, since it is less dense than the material around it.

C. Ocean crust is dense and composed mostly of basalt, while continental crust is lower in density and composed mostly of granite. Considering the density differences, would the buoyant force on a basaltic magma be greater in the ocean crust or the continental crust? Explain your reasoning.

Continental crust, since it has greater density difference between solid and liquid, has a greater buoyant force. Since the liquid magma of basalt is less dense than both solid crusts, the magma would rise faster in continental crust since there is a greater difference. Buoyancy will pull less on the liquid magma in oceanic crust.





## Part 2. Group Work

In Table C, align the driving energies that correspond with the hot air balloon and the magma. Not all aspects of the hot air balloon will necessarily align with magma. Explain how the hot air balloon and magma are different in Table D.

Table C. Comparing Hot Air Balloon and Magma

Hot Air Balloon	Magma	Driving Energy
Gas flame		thermal
Differences in air inside and outside the balloon		buoyancy (gravitational)
Balloon rising		buoyancy (gravitational)
Balloon floating		xxxx
Outside air heating up during the day		thermal

Describe specific factors that affect density and buoyancy for the hot air balloon system and the magma system.

Table D. Differences Between Hot Air Balloon and Magma

Hot Air Balloon	Difference	Magma
heat of day	Factors impacting density of balloon/magma	heat of
	Factors impacting buoyancy	

**Group Work Questions:**

A. Step back for a moment. In your group's own words, explain the following ideas:

**Gravitational energy:** Energy caused by atmospheric forces by the Earth

**Thermal energy:** Energy caused by the movement of molecules

**Chemical energy:** Energy caused by the changing of chemicals

**Buoyancy:** materials w/ different densities will fall or rise

**Lithosphere:** Crust of Earth <sup>underneath</sup> solid where earthquakes happen

**Asthenosphere:** Solid layer underneath lithosphere, that bends

**Why Melting Occurs at Subduction Zones:** Composition of the ocean floor contains water & it gets squeezed out into the asthenosphere which makes it melt

**MAKE SURE EVERYONE UNDERSTANDS THESE IDEAS BEFORE MOVING ON!**

B. When magma rises through the crust, the magma cools and the crust gets hotter as heat is transferred from the magma to the crust. Explain what happens to density during this process and how it will affect a magma rising through the crust:

**Magma cooling:** Magma's density will decrease when magma is hot it density decreases so it rises. When it cools it decreases and causes it to change comp

**Crust warming:** Crust's density will increase

C. Ocean crust is dense and composed mostly of basalt, while continental crust is lower in density and composed mostly of granite. Considering the density differences, would the buoyant force on a basaltic magma be greater in the ocean crust or the continental crust? Explain your reasoning.

10

**Class Notes**

Table A. Causal Principles and Hot Air Balloon

Hot Air Balloon	Driving Energy
Gas flame	Thermal energy
Differences in air inside and outside the balloon	Density differences - thermal energy (buoyancy)
Balloon rising	Gravitational energy
Balloon floating	— equilibrium
Outside air heating up during the day	Solar Thermal Energy

Table B. Causal Principles and Magma

Magma	Driving Energy
Water added to hot rocks deep underground	
Differences in the cold lithosphere and the hot magma	
Magma rising	
Magma solidifies and stops rising	
Oceanic lithosphere versus continental lithosphere	

(different members)

**Group Work Questions:**

A. Step back for a moment. In your group's own words, explain the following ideas:

Gravitational energy: Energy caused by atmospheric forces by the Earth.

Thermal energy: Energy caused by the movement of molecules

Chemical energy: Energy caused by the changing of chemical compositions

Buoyancy: Materials w/ different densities will rise or fall

Lithosphere: Underneath floor of Earth, solid layer where earthquakes happen

Asthenosphere: Solid layer underneath lithosphere that bends

Why Melting Occurs at Subduction Zones: Composition of the ocean floor contains water & it gets squeezed out into the asthenospheric rock where it causes it to melt

**MAKE SURE EVERYONE UNDERSTANDS THESE IDEAS BEFORE MOVING ON!**

B. When magma rises through the crust, the magma cools and the crust gets hotter as heat is transferred from the magma to the crust. Explain what happens to density during this process and how it will affect a magma rising through the crust:

Magma cooling: Magma's density will decrease when magma is hot, its density decreases so it rises. When it cools, it decreases & becomes a solid.

Crust warming: Crust's density will increase, allowing magma to go under the rising crust.

C. Ocean crust is dense and composed mostly of basalt, while continental crust is lower in density and composed mostly of granite. Considering the density differences, would the buoyant force on a basaltic magma be greater in the ocean crust or the continental crust? Explain your reasoning.

Ocean crust has a greater buoyant force because it's more dense

## Part 2. Group Work

In Table C, align the driving energies that correspond with the hot air balloon and the magma. Not all aspects of the hot air balloon will necessarily align with magma. Explain how the hot air balloon and magma are different in Table D.

Table C. Comparing Hot Air Balloon and Magma

Hot Air Balloon	Magma	Driving Energy
Gas flame	water added to hot rocks deep underground	Thermal — chemical
Differences in air inside and outside the balloon	Diff. in the cold lithosphere & magma	Density differences Thermal
Balloon rising	Magma Rising	Gravitational
Balloon floating	Magma Solidifies & stops rising	Equilibrium
Outside air heating up during the day	Oceanic lithosphere vs. continental	Solar Thermal / density Thermal

Describe specific factors that affect density and buoyancy for the hot air balloon system and the magma system.

Table D. Differences Between Hot Air Balloon and Magma

Hot Air Balloon	Difference	Magma
Thermal	Factors impacting density of balloon/magma	Composition
thermal	Factors impacting buoyancy	Thermal

**Group Work Questions:**

A. Step back for a moment. In your group's own words, explain the following ideas:

Gravitational energy: energy driven by gravity

Thermal energy: energy driven by temperature

Chemical energy: energy driven by chemical change or composition change

Buoyancy: Difference in density between two items

Lithosphere: solid part of tectonic plate above asthenosphere

Asthenosphere: solid piece @ mantle, below lithosphere

Why Melting Occurs at Subduction Zones: pressure changes temperature

**MAKE SURE EVERYONE UNDERSTANDS THESE IDEAS BEFORE MOVING ON!**

B. When magma rises through the crust, the magma cools and the crust gets hotter as heat is transferred from the magma to the crust. Explain what happens to density during this process and how it will affect a magma rising through the crust:

Magma cooling: ~~the magma cools~~

when magma cools it becomes less dense,  
and will rise through the crust because the  
crust is more dense

Crust warming:

When the crust warms, it becomes  
more dense, ~~with~~ which makes up  
the difference in buoyancy, causing the magma to rise.

C. Ocean crust is dense and composed mostly of basalt, while continental crust is lower in density and composed mostly of granite. Considering the density differences, would the buoyant force on a basaltic magma be greater in the ocean crust or the continental crust? Explain your reasoning.

the buoyant force of Basaltic magma would be greater in the continental crust because the composition of the magma is different than the composition of the continental crust, causing a difference in density, which makes it more buoyant

11

## Part 2. Group Work

In Table C, align the driving energies that correspond with the hot air balloon and the magma. Not all aspects of the hot air balloon will necessarily align with magma. Explain how the hot air balloon and magma are different in Table D.

Table C. Comparing Hot Air Balloon and Magma

Hot Air Balloon	Magma	Driving Energy
Gas flame		Thermal
Differences in air inside and outside the balloon	Differences in the solid lithosphere and the hot magma	Thermal Energy
Balloon rising	Magma Rising	Gravitational
Balloon floating	Magma solidifies and stop Rising	Equilibrium
Outside air heating up during the day		Solar energy → thermal Energy

Describe specific factors that affect density and buoyancy for the hot air balloon system and the magma system.

Table D. Differences Between Hot Air Balloon and Magma

Hot Air Balloon	Difference	Magma
Outside air temperature determines how hot the balloon needs to be in order to float.	Factors impacting density of balloon/magma	Pressure of the layers of the earth's surface on the magma underground affect where the magma will settle.
The density of the air is more dense than the air inside the balloon and therefore makes it	Factors impacting buoyancy	The pressure on the magma makes it less dense and therefore more buoyant.

more buoyant.

**Group Work Questions:**

A. Step back for a moment. In your group's own words, explain the following ideas:

*Gravitational energy:* Energy changes revolving around pressure changes

*Thermal energy:* Energy changes based on changes in temperature

*Chemical energy:* Energy changes based on changes in composition

*Buoyancy:* Things w/ different densities will separate in relation to one another

*Lithosphere:* area below the crust, goes under the tectonic plate

*Asthenosphere:* area below crust, goes above plate

*Why Melting Occurs at Subduction Zones:* Composition is altered from water (salt water + magma). Added water molecules → melting

**MAKE SURE EVERYONE UNDERSTANDS THESE IDEAS BEFORE MOVING ON!**

B. When magma rises through the crust, the magma cools and the crust gets hotter as heat is transferred from the magma to the crust. Explain what happens to density during this process and how it will affect a magma rising through the crust:

**Magma cooling:**

As magma rises density of it decreases, eventually as it rises higher its density will get higher again but the crust density will decrease. Just as heat is transferred, there are density exchanges.

**Crust warming:**

Additionally the density of crust decreases w/ increased temp. in order to make room for the density of the cooling magma that's coming in.

C. Ocean crust is dense and composed mostly of basalt, while continental crust is lower in density and composed mostly of granite. Considering the density differences, would the buoyant force on a basaltic magma be greater in the ocean crust or the continental crust? Explain your reasoning.

The continental crust – since buoyancy implies that things w/ different densities separate in relation to each other the force of the higher density (basalt) would be greater on the lower density composition (granite).



12

## Part 2. Group Work

In Table C, align the driving energies that correspond with the hot air balloon and the magma. Not all aspects of the hot air balloon will necessarily align with magma. Explain how the hot air balloon and magma are different in Table D.

Table C. Comparing Hot Air Balloon and Magma

Hot Air Balloon	Magma	Driving Energy
Gas flame	water added to hot rocks underground	Thermal
Differences in air inside and outside the balloon	Differences in cold lithosphere vs. magma	Differing densities due to thermal energy
Balloon rising	magma rising	Gravitational
Balloon floating	—	—
Outside air heating up during the day	Oceanic lithosphere vs. continental lithosphere	Thermal (Solar)

Describe specific factors that affect density and buoyancy for the hot air balloon system and the magma system.

Table D. Differences Between Hot Air Balloon and Magma

Hot Air Balloon	Difference	Magma
Temperature outside vs. inside the balloon	Factors impacting density of balloon/magma	cold lithosphere versus hot magma
Density changed	Factors impacting buoyancy	Density change of the magma

**Group Work Questions:**

A. Step back for a moment. In your group's own words, explain the following ideas:

Gravitational energy: draws objects together

Thermal energy: movement of molecules

Chemical energy: arrangement of molecules & atoms

Buoyancy: separating of different densities

Lithosphere: tectonic plates

Asthenosphere: layer under lithosphere (more dense)

Why Melting Occurs at Subduction Zones: composition and water

**MAKE SURE EVERYONE UNDERSTANDS THESE IDEAS BEFORE MOVING ON!**

B. When magma rises through the crust, the magma cools and the crust gets hotter as heat is transferred from the magma to the crust. Explain what happens to density during this process and how it will affect a magma rising through the crust:

Magma cooling:

increase density

Crust warming:

decrease density

C. Ocean crust is dense and composed mostly of basalt, while continental crust is lower in density and composed mostly of granite. Considering the density differences, would the buoyant force on a basaltic magma be greater in the ocean crust or the continental crust? Explain your reasoning.

It would be greater in the ocean crust  
because it is more dense than continental  
crust.

13

## Part 2. Group Work

In Table C, align the driving energies that correspond with the hot air balloon and the magma. Not all aspects of the hot air balloon will necessarily align with magma. Explain how the hot air balloon and magma are different in Table D.

Table C. Comparing Hot Air Balloon and Magma

Hot Air Balloon	Magma	Driving Energy
Gas flame	water added	thermal
Differences in air inside and outside the balloon	difference in cold lithosphere & hot magma	thermal
Balloon rising	magma rising	gravitation
Balloon floating	—	—
Outside air heating up during the day	oceanic lithosphere cooling down continental lithosphere	thermal, solar

Describe specific factors that affect density and buoyancy for the hot air balloon system and the magma system.

Table D. Differences Between Hot Air Balloon and Magma

Hot Air Balloon	Difference	Magma
temperature/ pressure	Factors impacting density of balloon/magma	Composition
Air Density	Factors impacting buoyancy	Composition / Density

**Group Work Questions:**

A. Step back for a moment. In your group's own words, explain the following ideas:

Gravitational energy:

Thermal energy: most related to the heating activities.

Chemical energy: the bonds within molecules breaks.

Buoyancy: upward force that keeps things float

Lithosphere: is the outer solid part of the earth, including the crust and upper mantle

Asthenosphere: is the ductile part of the earth, below the lithosphere

Why Melting Occurs at Subduction Zones:

Due to its inner composition. When water is added, the melting temperature goes down

**MAKE SURE EVERYONE UNDERSTANDS THESE IDEAS BEFORE MOVING ON!** pressure increase

B. When magma rises through the crust, the magma cools and the crust gets hotter as heat is transferred from the magma to the crust. Explain what happens to density during this process and how it will affect a magma rising through the crust:

Magma cooling: when temperature goes down, the density ↑.

Crust warming: when temperature goes up, the density ↓

C. Ocean crust is dense and composed mostly of basalt, while continental crust is lower in density and composed mostly of granite. Considering the density differences, would the buoyant force on a basaltic magma be greater in the ocean crust or the continental crust? Explain your reasoning.

The buoyant force on a Granite magma is greater because of its lower density.

ISP203A – Global Change  
Buoyancy

**Part 2. Group Work**

In Table C, align the driving energies that correspond with the hot air balloon and the magma. Not all aspects of the hot air balloon will necessarily align with magma. Explain how the hot air balloon and magma are different in Table D.

Table C. Comparing Hot Air Balloon and Magma

Hot Air Balloon	Magma	Driving Energy
Gas flame	water added to hot rocks underground	thermal
Differences in air inside and outside the balloon	diff. in cold lithosphere & hot magma	thermal
Balloon rising	magma rising	gravity
Balloon floating	magma solidifies & stops rising	equilibrium
Outside air heating up during the day	oceanic lithosphere V- cont. lithosphere	thermal

Describe specific factors that affect density and buoyancy for the hot air balloon system and the magma system.

Table D. Differences Between Hot Air Balloon and Magma

Hot Air Balloon	Difference	Magma
as you get higher in atmosphere air is less dense	Factors impacting density of balloon/magma	lithosphere is less dense than atmosphere
temp. of air inside & outside balloon	Factors impacting buoyancy	oceanic lithosphere V- continental lithosphere

**Group Work Questions:**

A. Step back for a moment. In your group's own words, explain the following ideas:

*Gravitational energy:*

*Thermal energy:* Processes happening b/c of <sup>differences</sup> ~~changes~~ in density, etc.

*Chemical energy:* Changes in composition

*Buoyancy:* Force equal to weight of matter object displaces

*Lithosphere:* brittle upper layer of crust

*Asthenosphere:* bendable lower layer of crust

*Why Melting Occurs at Subduction Zones:* because of water added changing the composition

**MAKE SURE EVERYONE UNDERSTANDS THESE IDEAS BEFORE MOVING ON!**

B. When magma rises through the crust, the magma cools and the crust gets hotter as heat is transferred from the magma to the crust. Explain what happens to density during this process and how it will affect a magma rising through the crust:

*Magma cooling:* Magma is less dense than surrounding crust which causes it to "sink less" through the crust. As it comes into contact with the cold crust the heat is transferred to the crust cooling it down. Magma becomes <sup>more</sup> ~~less~~ dense and crust warmer/less dense until they are at equilibrium.

*Crust warming:*

C. Ocean crust is dense and composed mostly of basalt, while continental crust is lower in density and composed mostly of granite. Considering the density differences, would the buoyant force on a basaltic magma be greater in the ocean crust or the continental crust? Explain your reasoning.

The basaltic magma would be more dense in the continental crust. This will happen because ocean crust is more dense than continental crust because it is composed mostly of basalt. Because the continental crust is less dense, the basalt magma would have a greater buoyant force on the continental crust.

ISP203A – Global Change  
Buoyancy

**Class Notes**

Table A. Causal Principles and Hot Air Balloon

Hot Air Balloon	Driving Energy
Gas flame	Thermal Energy
Differences in air inside and outside the balloon	Density differences; thermal energy (buoyancy!)
Balloon rising	Gravitational Energy
Balloon floating	XXX
Outside air heating up during the day	Solar energy (thermal)

Table B. Causal Principles and Magma

Magma	Driving Energy
Water added to hot rocks deep underground	Chemical Energy
Differences in the cold lithosphere and the hot magma	Thermal Energy
Magma rising	Gravitational
Magma solidifies and stops rising	Gravitational + Chemical
Oceanic lithosphere versus continental lithosphere	Different compositions

GROUP #: 10

Student IDs of Members Present:

43145662 - [REDACTED]  
37497903 - Ka [REDACTED]  
40974799 - A [REDACTED] DS

**Group Work Questions:**

A. Step back for a moment. In your group's own words, explain the following ideas:

Gravitational energy: pulls matter towards center of the Earth

Thermal energy: heat energy

Chemical energy:

Buoyancy: force is equal to weight the object displaces

Lithosphere: crust + upper mantle (plates)

Asthenosphere: lower mantle

Why Melting Occurs at Subduction Zones: composition changes

**MAKE SURE EVERYONE UNDERSTANDS THESE IDEAS BEFORE MOVING ON!**

B. When magma rises through the crust, the magma cools and the crust gets hotter as heat is transferred from the magma to the crust. Explain what happens to density during this process and how it will affect a magma rising through the crust:

Magma cooling: density decreases / temp decreases  
pressure increases  
7

Crust warming:

Density decreases  
Pressure increases

C. Ocean crust is dense and composed mostly of basalt, while continental crust is lower in density and composed mostly of granite. Considering the density differences, would the buoyant force on a basaltic magma be greater in the ocean crust or the continental crust? Explain your reasoning.

RAN OUT OF TIME



## Part 2. Group Work

In Table C, align the driving energies that correspond with the hot air balloon and the magma. Not all aspects of the hot air balloon will necessarily align with magma. Explain how the hot air balloon and magma are different in Table D.

Table C. Comparing Hot Air Balloon and Magma

Hot Air Balloon	Magma	Driving Energy
Gas flame	water added to hot rocks deep underground	Thermal
Differences in air inside and outside the balloon	differences in cold lithosphere and hot magma	density differences : thermal energy (buoyancy)
Balloon rising	magma rising	gravitational energy
Balloon floating		
Outside air heating up during the day	oceanic lithosphere vs. continental lithosphere	solar energy (thermal energy)

Describe specific factors that affect density and buoyancy for the hot air balloon system and the magma system.

Table D. Differences Between Hot Air Balloon and Magma

Hot Air Balloon	Difference	Magma
temperature	Factors impacting density of balloon/magma	composition
temperature	Factors impacting buoyancy	pressure

**Group Work Questions:**

A. Step back for a moment. In your group's own words, explain the following ideas:

Gravitational energy: The force of gravity

Thermal energy: Heat produced

Chemical energy: the energy created when bonds break and reform

Buoyancy: upward lifting force in liquids

Lithosphere: outer solid plate of earth

Asthenosphere: soft area under lithosphere

Why Melting Occurs at Subduction Zones: When plates collide, the heat created from the contact

**MAKE SURE EVERYONE UNDERSTANDS THESE IDEAS BEFORE MOVING ON!**

B. When magma rises through the crust, the magma cools and the crust gets hotter as heat is transferred from the magma to the crust. Explain what happens to density during this process and how it will affect a magma rising through the crust:

Magma cooling: The density of magma must be lower than crust

Crust warming: The density of the crust must be higher than the magma

C. Ocean crust is dense and composed mostly of basalt, while continental crust is lower in density and composed mostly of granite. Considering the density differences, would the buoyant force on a basaltic magma be greater in the ocean crust or the continental crust? Explain your reasoning.

~~No~~ Continental crust. Because it is less dense it is easier for the magma to push through

...the ...ergies that correspond with the hot air balloon and the ...  
 ...ma. Not all aspects of the hot air balloon will necessarily align with magma. Explain  
 how the hot air balloon and magma are different in Table D.

Table C. Comparing Hot Air Balloon and Magma

Hot Air Balloon	Magma	Driving Energy
Gas flame	Water added to rocks underground	Thermal energy
Differences in air inside and outside the balloon	Differences in the lithosphere and the magma	Density differences due to heat
Balloon rising	magma rising	Gravitational energy
Balloon floating	Magma solidifies and stops rising	Solar (Thermal) energy
Outside air heating up during the day	Oceanic lithosphere vs. Continental	N/A

Describe specific factors that affect density and buoyancy for the hot air balloon system  
 and the magma system.

Table D. Differences Between Hot Air Balloon and Magma

Hot Air Balloon	Difference	Magma
Temp of air, how much fuel one has	Factors impacting density of balloon/magma	Temp of crust
Temp/heat	Factors impacting buoyancy	Density

**Group Work Questions:**

A. Step back for a moment. In your group's own words, explain the following ideas:

Gravitational energy: The energy pulling objects toward the center of a body (planet, star, etc.)

Thermal energy: Heat energy. Solar radiation, etc. included is thermodynamic reactions.

Chemical energy: Energy within bonds.

Buoyancy: Different densities of materials resulting in "floating" based on density.

Lithosphere: Part of the crust, cool and brittle.

Asthenosphere: Upper part of the mantle, warm and "plastic-like."

Why Melting Occurs at Subduction Zones: At subduction zones, the subducting plate

**MAKE SURE EVERYONE UNDERSTANDS THESE IDEAS BEFORE MOVING ON!**

B. When magma rises through the crust, the magma cools and the crust gets hotter as heat is transferred from the magma to the crust. Explain what happens to density during this process and how it will affect a magma rising through the crust:

Magma cooling:

As magma rises and cools, its density increases, and its movement through the crust will slow and stop as it achieves the density and pressure equilibrium with the crust.

Crust warming:

As the crust warms, its density decreases and its buoyancy comes nearer to that of the magma, which slows in its rise.

C. Ocean crust is dense and composed mostly of basalt, while continental crust is lower in density and composed mostly of granite. Considering the density differences, would the buoyant force on a basaltic magma be greater in the ocean crust or the continental crust? Explain your reasoning.

The buoyant force would be greater in ocean crust, because the ocean crust is denser and heavier, and thus displaces a greater weight than the less dense, lighter oceanic crust.

ISP203A – Global Change  
Buoyancy

**Part 2. Group Work**

In Table C, align the driving energies that correspond with the hot air balloon and the magma. Not all aspects of the hot air balloon will necessarily align with magma. Explain how the hot air balloon and magma are different in Table D.

Table C. Comparing Hot Air Balloon and Magma

Hot Air Balloon	Magma	Driving Energy
Gas flame	Water bonding with rocks in the asthenosphere	Shear in the first, shear in the second - both reduce the density
Differences in air inside and outside the balloon	Differences in cold lithosphere, the asthenosphere and magma	There are density differences
Balloon rising	Magma rising	Gravitational energy and the action of buoyancy force
Balloon floating	Magma cooling, solidifying and stopping	Equilibrium of buoyancy force
Outside air heating up during the day	Cooling of magma as it rises and solidifies	Shear energy affecting buoyancy force

Describe specific factors that affect density and buoyancy for the hot air balloon system and the magma system.

Table D. Differences Between Hot Air Balloon and Magma

Hot Air Balloon	Difference	Magma
Heat reduces density	Factors impacting density of balloon/magma	Water bonding reduces density The heat in this system is decreasing as well
Temperature	Factors impacting buoyancy	Compressions Temperature as magma solidifies of magma

GROUP #: 20

Student IDs of Members Present:

~~XXXXXXXXXX~~ A4181466 A41850835  
~~XXXXXXXXXX~~ A41918016  
A43332855

A42213991

**Group Work Questions:**

A. Step back for a moment. In your group's own words, explain the following ideas:

Gravitational energy: energy resulting from gravitational field

Thermal energy: energy

Chemical energy: energy from chemical reactions or changes of state

Buoyancy: rise/fall based on density

Lithosphere:

Asthenosphere:

Why Melting Occurs at Subduction Zones:

water is being added to the asthenosphere, changing the composition

**MAKE SURE EVERYONE UNDERSTANDS THESE IDEAS BEFORE MOVING ON!**

B. When magma rises through the crust, the magma cools and the crust gets hotter as heat is transferred from the magma to the crust. Explain what happens to density during this process and how it will affect a magma rising through the crust:

Magma cooling:

The magma gets denser as it cools, and rise slower.

Crust warming:

As the crust warms, it becomes less dense, making the magma rise faster.

C. Ocean crust is dense and composed mostly of basalt, while continental crust is lower in density and composed mostly of granite. Considering the density differences, would the buoyant force on a basaltic magma be greater in the ocean crust or the continental crust? Explain your reasoning.

Continental crust because it has lower density. This means it has a higher buoyant force.

## Buoyancy

## Part 2. Group Work

In Table C, align the driving energies that correspond with the hot air balloon and the magma. Not all aspects of the hot air balloon will necessarily align with magma. Explain how the hot air balloon and magma are different in Table D.

Table C. Comparing Hot Air Balloon and Magma

Hot Air Balloon	Magma	Driving Energy
Gas flame	water added to hot rocks deep underground	thermal energy
Differences in air inside and outside the balloon	differences in the cold lithosphere and the hot magma	density difference, thermal buoyancy
Balloon rising	magma rising	gravitational
Balloon floating	magma solidifies, stops rising	equilibrium
Outside air heating up during the day	—	thermal energy

Describe specific factors that affect density and buoyancy for the hot air balloon system and the magma system.

Table D. Differences Between Hot Air Balloon and Magma

Hot Air Balloon	Difference	Magma
temperature	Factors impacting density of balloon/magma	Composition
temperature	Factors impacting buoyancy	<del>composition</del> pressure

**Group Work Questions:**

A. Step back for a moment. In your group's own words, explain the following ideas:

*Gravitational energy:* energy associated with a gravitational field.

*Thermal energy:* energy in the form of heat.

*Chemical energy:* potential energy stored in the chemical bonds of molecules.

*Buoyancy:* upward force caused by fluid pressure keeps objects afloat.

*Lithosphere:* rigid outer part of the earth, composed of the crust and mantle.

*Asthenosphere:* the upper, plastic, layer of Earth's mantle.

*Why Melting Occurs at Subduction Zones:* Tectonic movement and hydration melting.

**MAKE SURE EVERYONE UNDERSTANDS THESE IDEAS BEFORE MOVING ON!**

B. When magma rises through the crust, the magma cools and the crust gets hotter as heat is transferred from the magma to the crust. Explain what happens to density during this process and how it will affect a magma rising through the crust:

*Magma cooling:* Magma loses thermal energy, solidifies, and becomes more dense during the process of solidification.

*Crust warming:* Hydration melting and change in the composition of molten rock beneath the Earth's surface.

C. Ocean crust is dense and composed mostly of basalt, while continental crust is lower in density and composed mostly of granite. Considering the density differences, would the buoyant force on a basaltic magma be greater in the ocean crust or the continental crust? Explain your reasoning.

*The density gradient between the basaltic magma and continental crust composed of granite.*

*(When basaltic magma cools it obtains a density similar to oceanic crust.*



ISP203A – Global Change  
Buoyancy

**Part 2. Group Work**

In Table C, align the driving energies that correspond with the hot air balloon and the magma. Not all aspects of the hot air balloon will necessarily align with magma. Explain how the hot air balloon and magma are different in Table D.

Table C. Comparing Hot Air Balloon and Magma

Hot Air Balloon	Magma	Driving Energy
Gas flame	Radioactive decay + residual heat	Thermal energy
Differences in air inside and outside the balloon	Solidification + melting	Density gradients (buoyancy)
Balloon rising	Surrounding material	Gravitational energy
Balloon floating	surrounding material	Buoyant forces
Outside air heating up during the day	N/A	Solar radiation; thermal energy

Describe specific factors that affect density and buoyancy for the hot air balloon system and the magma system.

Table D. Differences Between Hot Air Balloon and Magma

Hot Air Balloon	Difference	Magma
Flame	Factors impacting density of balloon/magma	Hydration melting
Density gradient surrounding air	Factors impacting buoyancy	Density gradient surrounding material

ISP203A – Global Change  
Buoyancy

GROUP #: 28

Student IDs of Members Present:

A42829869 A41729348

A37669797 A42839439

**Group Work Questions:**

A. Step back for a moment. In your group's own words, explain the following ideas:

Gravitational energy: Energy in objects falling or rising.

Thermal energy: Energy from the movement of molecules, higher temp move faster.

Chemical energy: Energy driving a phase change.

Buoyancy: caused by density differences, materials rise or fall.

Lithosphere: the outer most part of the earth, the crust.

Asthenosphere: Below lithosphere, plates move because of asthenosphere: Lithosphere.

Why Melting Occurs at Subduction Zones: Water changes the composition, temp changes.

**MAKE SURE EVERYONE UNDERSTANDS THESE IDEAS BEFORE MOVING ON!**

B. When magma rises through the crust, the magma cools and the crust gets hotter as heat is transferred from the magma to the crust. Explain what happens to density during this process and how it will affect a magma rising through the crust:

Magma cooling:

Crust warming:

C. Ocean crust is dense and composed mostly of basalt, while continental crust is lower in density and composed mostly of granite. Considering the density differences, would the buoyant force on a basaltic magma be greater in the ocean crust or the continental crust? Explain your reasoning.

ISP203A – Global Change  
Buoyancy

**Part 2. Group Work**

In Table C, align the driving energies that correspond with the hot air balloon and the magma. Not all aspects of the hot air balloon will necessarily align with magma. Explain how the hot air balloon and magma are different in Table D.

Table C. Comparing Hot Air Balloon and Magma

Hot Air Balloon	Magma	Driving Energy
Gas flame	water added to hot rocks deep underground	Thermal
Differences in air inside and outside the balloon	Difference in cold lithosphere and hot magma	Thermal
Balloon rising	Magma Rising	Gravitational
Balloon floating	Magma solidifies and stop rising	Equilibrium
Outside air heating up during the day	Oceanic Lithosphere vs. Continental Lithosphere	Density Difference

Describe specific factors that affect density and buoyancy for the hot air balloon system and the magma system.

Table D. Differences Between Hot Air Balloon and Magma

Hot Air Balloon	Difference	Magma
Difference in Air inside and outside the balloon	Factors impacting density of balloon/magma	Difference in cold lithosphere and hot magma
dr. Warm air rising, gravitational energy, density diff. due to thermal energy	Factors impacting buoyancy	oceanic lithosphere vs. continental lithosphere

thermal energy

GROUP #: 23  
Student IDs of Members Present:  
A39474585  
A39732455 A43050270

**Group Work Questions:**

A. Step back for a moment. In your group's own words, explain the following ideas:

Gravitational energy: The force of gravity acting upon an object

Thermal energy: energy obtained from heat

Chemical energy: energy formed from bonds breaking/forming

Buoyancy: less dense objects float on more dense objects which sink

Lithosphere: above asthenosphere includes crust

Asthenosphere: solid material, bends like silly putty, melts

Why Melting Occurs at Subduction Zones: composition changes because of

**MAKE SURE EVERYONE UNDERSTANDS THESE IDEAS BEFORE MOVING ON!**

B. When magma rises through the crust, the magma cools and the crust gets hotter as heat is transferred from the magma to the crust. Explain what happens to density during this process and how it will affect a magma rising through the crust:

Magma cooling: When magma cools, it becomes more dense and will eventually rise at a slower rate and will harden

Crust warming: The warming crust will become less dense and will rise above the magma

C. Ocean crust is dense and composed mostly of basalt, while continental crust is lower in density and composed mostly of granite. Considering the density differences, would the buoyant force on a basaltic magma be greater in the ocean crust or the continental crust? Explain your reasoning.

The ocean crust is more dense so the buoyant force between the crust & magma will be greater. Greater density differences = greater buoyant forces.

group 23  
A39474585  
A39732455  
A43050270

## Part 2. Group Work

In Table C, align the driving energies that correspond with the hot air balloon and the magma. Not all aspects of the hot air balloon will necessarily align with magma. Explain how the hot air balloon and magma are different in Table D.

Table C. Comparing Hot Air Balloon and Magma

Hot Air Balloon	Magma	Driving Energy
Gas flame	Water added to hot rocks underground	thermal
Differences in air inside and outside the balloon	diff. in the cold lith. & hot magma	thermal
Balloon rising	magma rising	gravitational
Balloon floating	magma solidifies & stops rising	XXX
Outside air heating up during the day	oceanic lith. versus continental lith.	solar (thermal)

Describe specific factors that affect density and buoyancy for the hot air balloon system and the magma system.

Table D. Differences Between Hot Air Balloon and Magma

Hot Air Balloon	Difference	Magma
Fire Flame heats air in balloon Sun heats atmosphere	Factors impacting density of balloon/magma	Water added to hot rocks cold lithosphere
difference in air in balloon vs outside	Factors impacting buoyancy	hot liquid rocks are less dense ∴ rise in solid lithosphere

**Group Work Questions:**

A. Step back for a moment. In your group's own words, explain the following ideas:

*Gravitational energy:* the force by which matter attracts matter

*Thermal energy:* the movement of atoms and molecules that results in heat.

*Chemical energy:* energy released by chemical reaction.

*Buoyancy:* upward acting force of fluid.

*Lithosphere:* Outer layer of Earth (crust, mantle)

*Asthenosphere:* Ductile part of the earth.

*Why Melting Occurs at Subduction Zones:* pressure and heat generated by moving matter.

**MAKE SURE EVERYONE UNDERSTANDS THESE IDEAS BEFORE MOVING ON!**

B. When magma rises through the crust, the magma cools and the crust gets hotter as heat is transferred from the magma to the crust. Explain what happens to density during this process and how it will affect a magma rising through the crust:

*Magma cooling:* As the magma heats up it is less dense than the earth around it so it rises to the surface. Once it starts to cool the igneous rock has a greater density but is still less dense than surrounding rocks.

*Crust warming:*

The crust is less dense when heating up which allows the magma to push it up as it reaches the surface. As the crust cools its density increases again.

C. Ocean crust is dense and composed mostly of basalt, while continental crust is lower in density and composed mostly of granite. Considering the density differences, would the buoyant force on a basaltic magma be greater in the ocean crust or the continental crust? Explain your reasoning.

The ocean crust would be more buoyant because it has a greater density.

ISP203A – Global Change  
Buoyancy

**Part 2. Group Work**

In Table C, align the driving energies that correspond with the hot air balloon and the magma. Not all aspects of the hot air balloon will necessarily align with magma. Explain how the hot air balloon and magma are different in Table D.

Table C. Comparing Hot Air Balloon and Magma

Hot Air Balloon	Magma	Driving Energy
Gas flame	water added to hot rocks.	Thermal
Differences in air inside and outside the balloon	Cold lithosphere hot magma	Thermal
Balloon rising	Density of magma	Gravitational, Thermal
Balloon floating	no relation	None
Outside air heating up during the day	cools when reaches surface	Thermal

Describe specific factors that affect density and buoyancy for the hot air balloon system and the magma system.

Table D. Differences Between Hot Air Balloon and Magma

Hot Air Balloon	Difference	Magma
Temperature	Factors impacting density of balloon/magma	Temperature composition.
weight inside balloon	Factors impacting buoyancy	location of magma in chambers.

**Group Work Questions:**

A. Step back for a moment. In your group's own words, explain the following ideas:

Gravitational energy: natural tendencies of things being pulled toward the earth's <sup>core</sup>

Thermal energy: speed of the molecules

Chemical energy: when the form changes

Buoyancy: depends on the amount of stuff in it.

Lithosphere: where earthquakes occur

Asthenosphere: solid but bends

Why Melting Occurs at Subduction Zones: composition

**MAKE SURE EVERYONE UNDERSTANDS THESE IDEAS BEFORE MOVING ON!**

B. When magma rises through the crust, the magma cools and the crust gets hotter as heat is transferred from the magma to the crust. Explain what happens to density during this process and how it will affect a magma rising through the crust:

Magma cooling:

density is going **up**. Depending on the temperature, the warmer the magma, the higher it rises. Faster the magma will reach the crust.

Crust warming:

density is going **down**. As the crust warms it is easier for the magma to rise. It begins to reach equilibrium.

C. Ocean crust is dense and composed mostly of basalt, while continental crust is lower in density and composed mostly of granite. Considering the density differences, would the buoyant force on a basaltic magma be greater in the ocean crust or the continental crust? Explain your reasoning.

Greater because the density differences are greater.



ISP203A – Global Change  
Buoyancy

**Part 2. Group Work**

In Table C, align the driving energies that correspond with the hot air balloon and the magma. Not all aspects of the hot air balloon will necessarily align with magma. Explain how the hot air balloon and magma are different in Table D.

Table C. Comparing Hot Air Balloon and Magma

Hot Air Balloon	Magma	Driving Energy
Gas flame	heat from core	thermal
Differences in air inside and outside the balloon	difference in composition of air	thermal
Balloon rising	magma rising	gravitational
Balloon floating	<del>Magma floating</del>	xxx equilibrium
Outside air heating up during the day	temp increases as you go down	Solar energy thermal

Describe specific factors that affect density and buoyancy for the hot air balloon system and the magma system.

Table D. Differences Between Hot Air Balloon and Magma

Hot Air Balloon	Difference	Magma
temperature	Factors impacting density of balloon/magma	pressure / temperature composition
Surrounding air	Factors impacting buoyancy	composition

**Group Work Questions:**

A. Step back for a moment. In your group's own words, explain the following ideas:

*Gravitational energy:* Energy due to

*Thermal energy:* Energy due to movement of molecules

*Chemical energy:* Energy due to change in molecular composition (bond)

*Buoyancy:* the power to float or rise in a fluid due to density.

*Lithosphere:* the crust & upper mantle of the earth

*Asthenosphere:* solid, bendy region below the lithosphere

*Why Melting Occurs at Subduction Zones:* Composition – salt water is added to magma & trapped in crystals. Then water (in gaseous state) rises & melts rocks

**MAKE SURE EVERYONE UNDERSTANDS THESE IDEAS BEFORE MOVING ON!**

B. When magma rises through the crust, the magma cools and the crust gets hotter as heat is transferred from the magma to the crust. Explain what happens to density during this process and how it will affect a magma rising through the crust:

**Magma cooling:**

When the magma cools (temperature drops), and density decreases as well. The density difference decreases, eliminating buoyancy so the magma stops rising.

**Crust warming:**

When the crust heats, the density increases. The density difference increases, causing magma to rise through the crust and the crust to "sink".

C. Ocean crust is dense and composed mostly of basalt, while continental crust is lower in density and composed mostly of granite. Considering the density differences, would the buoyant force on a basaltic magma be greater in the ocean crust or the continental crust? Explain your reasoning.

Basaltic magma would have a larger density difference in the continental crust and therefore the buoyant force would be greater.

ISP203A – Global Change  
Buoyancy

A42422266

A42669614

A40967142

A42704999

**Part 2. Group Work**

In Table C, align the driving energies that correspond with the hot air balloon and the magma. Not all aspects of the hot air balloon will necessarily align with magma. Explain how the hot air balloon and magma are different in Table D.

Table C. Comparing Hot Air Balloon and Magma

Hot Air Balloon	Magma	Driving Energy
Gas flame	—	thermal energy
Differences in air inside and outside the balloon	Differences in the cold lithosphere & hot magma	density differences due to temperature
Balloon rising	Magma rising	gravitational energy
Balloon floating	Magma solidifies & stops rising	xxx
Outside air heating up during the day	—	solar energy, thermal energy

Describe specific factors that affect density and buoyancy for the hot air balloon system and the magma system.

Table D. Differences Between Hot Air Balloon and Magma

Hot Air Balloon	Difference	Magma
Gas flame	Factors impacting density of balloon/magma	Oceanic lithosphere versus continental lithosphere Water added to hot rocks deep underground
Outside air heating up during the day Differences in air inside & outside the balloon	Factors impacting buoyancy	Differences in the cold lithosphere & hot magma

**Group Work Questions:**

A. Step back for a moment. In your group's own words, explain the following ideas:

*Gravitational energy: Energy caused by forces of gravity*

*Thermal energy: Energy caused by changes in temperature*

*Chemical energy: Energy from breaking/forming of bonds*

*Buoyancy: Rising/falling caused by differences in density*

*Lithosphere: The solid layer between the crust & asthenosphere*

*Asthenosphere: The layer ~~below~~ under the lithosphere*

*Why Melting Occurs at Subduction Zones: Thermal energy & density differences*

**MAKE SURE EVERYONE UNDERSTANDS THESE IDEAS BEFORE MOVING ON!**

B. When magma rises through the crust, the magma cools and the crust gets hotter as heat is transferred from the magma to the crust. Explain what happens to density during this process and how it will affect a magma rising through the crust:

*Magma cooling: Magma has a lesser density so it rises through the crust where it cools and becomes more dense, becoming equal w/ the crust and it*

*Crust warming: It becomes less dense allowing magma to rise through*

C. Ocean crust is dense and composed mostly of basalt, while continental crust is lower in density and composed mostly of granite. Considering the density differences, would the buoyant force on a basaltic magma be greater in the ocean crust or the continental crust? Explain your reasoning.

*In the ocean because there is a greater difference between densities of magma & ocean crust*

ISP203A – Global Change  
Buoyancy

**Part 2. Group Work**

In Table C, align the driving energies that correspond with the hot air balloon and the magma. Not all aspects of the hot air balloon will necessarily align with magma. Explain how the hot air balloon and magma are different in Table D.

Table C. Comparing Hot Air Balloon and Magma

Hot Air Balloon	Magma	Driving Energy
Gas flame	Water	Thermal energy
Differences in air inside and outside the balloon	Differences in the cold & hot magma	Thermal energy/buoyancy
Balloon rising	Magma rising	Gravitational/buoyancy
Balloon floating	Magma solidifies & stops rising	Equilibrium
Outside air heating up during the day	Oceanic lithosphere vs continental lithosphere	Thermal energy

Describe specific factors that affect density and buoyancy for the hot air balloon system and the magma system.

Table D. Differences Between Hot Air Balloon and Magma

Hot Air Balloon	Difference	Magma
<del>Thermal energy</del> Gas flame	Factors impacting density of balloon/magma	<del>Pressure</del> Water
Differences in air inside & outside	Factors impacting buoyancy	Differences in hot & cold magma

**Group Work Questions:**

A. Step back for a moment. In your group's own words, explain the following ideas:

Gravitational energy: energy that draws objects together

Thermal energy: energy from movement of molecules

Chemical energy: energy due to arrangement of atoms in molecules

Buoyancy: causes materials to rise or fall due to relative density.

Lithosphere: solid, brittle, above asthenosphere

Asthenosphere: solid, ~~hard~~ yet malleable.

Why Melting Occurs at Subduction Zones: differences in composition in addition to water.

**MAKE SURE EVERYONE UNDERSTANDS THESE IDEAS BEFORE MOVING ON!**

B. When magma rises through the crust, the magma cools and the crust gets hotter as heat is transferred from the magma to the crust. Explain what happens to density during this process and how it will affect a magma rising through the crust:

Magma cooling: Density increases as magma cools and slows rising of magma.

Crust warming: density decreases, slow process of magma rising.

C. Ocean crust is dense and composed mostly of basalt, while continental crust is lower in density and composed mostly of granite. Considering the density differences, would the buoyant force on a basaltic magma be greater in the ocean crust or the continental crust? Explain your reasoning.

ISP203A – Global Change  
Buoyancy

**Part 2. Group Work**

In Table C, align the driving energies that correspond with the hot air balloon and the magma. Not all aspects of the hot air balloon will necessarily align with magma. Explain how the hot air balloon and magma are different in Table D.

Table C. Comparing Hot Air Balloon and Magma

Hot Air Balloon	Magma	Driving Energy
Gas flame	water added to hot rocks deep underground	Thermal
Differences in air inside and outside the balloon	Differences in the cold lithosphere and the hot magma	Thermal
Balloon rising	magma rising	Gravitational
Balloon floating	magma solidifies and stops rising	Equilibrium
Outside air heating up during the day	oceanic lithosphere versus continental lithosphere	solar / Thermal

Describe specific factors that affect density and buoyancy for the hot air balloon system and the magma system.

Table D. Differences Between Hot Air Balloon and Magma

Hot Air Balloon	Difference	Magma
Temp in air Pressure in air	Factors impacting density of balloon/magma	Temp in earth Pressure in earth
Gravity	Factors impacting buoyancy	Gravity

GROUP #: 30

Student IDs of Members Present:

~~John P. Smith~~ A43425519  
~~Tom Smith~~ A42894705  
~~Michael L. Lippard~~ A44266728  
~~Alipha~~ A41387501

**Group Work Questions:**

A. Step back for a moment. In your group's own words, explain the following ideas:

Gravitational energy: energy caused by a pull from the earth or another object

Thermal energy: a change in energy caused by heat

Chemical energy: a change in how molecules are arranged

Buoyancy: density of an object compared to the density of objects around it.

Lithosphere: a layer of earth between crust and asthenosphere

Asthenosphere: layer of earth under the lithosphere

Why Melting Occurs at Subduction Zones: water, pressure, temperature

**MAKE SURE EVERYONE UNDERSTANDS THESE IDEAS BEFORE MOVING ON!**

B. When magma rises through the crust, the magma cools and the crust gets hotter as heat is transferred from the magma to the crust. Explain what happens to density during this process and how it will affect a magma rising through the crust:

Magma cooling:

The magma would not rise and start to get hard. As the magma cools it becomes less dense preventing it to rise any more. Also, because it is becoming less dense the magma becomes hard and turns to rock.

Crust warming:

Due to the magma, the crust temperature was rising causing it to be less dense

C. Ocean crust is dense and composed mostly of basalt, while continental crust is lower in density and composed mostly of granite. Considering the density differences, would the buoyant force on a basaltic magma be greater in the ocean crust or the continental crust? Explain your reasoning.

greater in continental crust because basaltic magma would be less dense than granite



ISP203A – Global Change  
Buoyancy

**Part 2. Group Work**

In Table C, align the driving energies that correspond with the hot air balloon and the magma. Not all aspects of the hot air balloon will necessarily align with magma. Explain how the hot air balloon and magma are different in Table D.

Table C. Comparing Hot Air Balloon and Magma

Hot Air Balloon	Magma	Driving Energy
Gas flame	water added to hot rocks deep underground	Thermal energy
Differences in air inside and outside the balloon	Differences in the cold lithosphere and the hot magma	Density Differences Thermal Energy (Buoyancy)
Balloon rising	Magma rising	Gravitational Energy
Balloon floating	Magma solidifies and stops rising	equilibrium
Outside air heating up during the day	Ocean lithosphere vs. continental lithosphere	Solar energy (Thermal Energy)

Describe specific factors that affect density and buoyancy for the hot air balloon system and the magma system.

Table D. Differences Between Hot Air Balloon and Magma

Hot Air Balloon	Difference	Magma
Gas flame, density of air around balloon, Temperature of balloon & air.	Factors impacting density of balloon/magma	Difference of cold lithosphere and the hot magma Temperature of the water added to the hot rocks
Density of balloon and hot air balloon.	Factors impacting buoyancy	Differences in the cold lithosphere and the hot magma